BIOPHYSICS.—*Effect of nutrient cultures on the reaction of maize seedlings to light.*[1] J. H. KEMPTON, Bureau of Plant Industry.

Following the demonstration that cultures of nutrient salts increased the size of maize seedlings grown in the dark,[2] it became of interest to determine how the cultures affected the reaction of plants to brief periods of illumination. The present paper reports on a single experiment testing this point.

The nutrient culture used was that given by Eaton[3] at double his concentration and modified by increasing KH_2PO_4 by a factor of 10. The control culture was grown with distilled water.

The plantings were made in coarse, crushed quartz in 40 tin ointment cans covered with tin-sealed tubes. Each can, containing 600 grams of oven-dried quartz moistened with 120 cc of solution or distilled water, was planted with 20 seeds of Funk Yellow Dent. Seed weights were recorded for each lot of 20 seeds.

The cans were kept in a dark room where the air temperature ranged from 85° to 86° F. Four days after planting, one-half the cans from each culture were chosen at random and arranged in a circle at such a distance from a 1,000-watt Mazda lamp as to give each can 100 foot-candles illumination. A strong blast of air was blown just under the lamp at about 3 feet above the plants to prevent, so far as possible, a rise in air temperature. The plants were exposed to this illumination for 1 hour, after which they were again enclosed in tin tubes and left in the dark. During the light exposure the air temperature rose 2° F. Twenty-four hours later the experiment was terminated and the seedlings were measured. Lengths were recorded separately for mesocotyls and coleoptiles. No leaves had appeared at this date—five days after planting. These parts, together with the roots and seed residues, were washed free of the coarse quartz and oven dried at 100° C. The several seedling parts were weighed as products of single cans—not as individual plants. The measures expressed as means of individuals are given in Table 1 and the analyses of variance are shown in Table 2.

The reaction to light was actually and relatively much greater in the plants grown in the salt solution than in those grown in distilled water. This is shown by the length and weight of mesocotyl, as well as in weight of tops (Figs. 1 and 2A; 2B). The roots were not appreciably affected by the culture or by the light exposure given the tops (Fig.

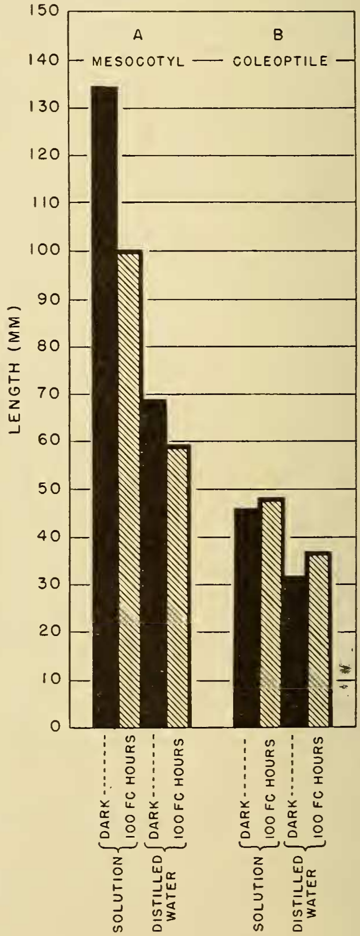

Fig. 1.—Mean length (mm) of mesocotyl (A) and coleoptile (B) of maize seedlings grown in distilled water and in nutrient solution. Solid bars represent seedlings always in the dark, hatched bars seedlings subjected to 100 foot-candle-hours of Mazda light four days after planting.

[1] Received July 31, 1942.

[2] KEMPTON, in press. Journ. Agr. Res.

[3] Journ. Agr. Res. 53: 433–444. September 1936.

2C). The result confirms previous experiments as to the lack of response of roots to culture solutions.[2] The exposure to 100 foot-candle-hours of Mazda increased the length of the coleoptile by a significant amount in the distilled water culture but only slightly in solution (Fig. 1B).

In conformity with the increase in seedling weight, the seed residue shows less material remaining in the seeds planted in the salt solution than in those in distilled water (Fig. 3A). There was little difference between the four treatments in the total amount of dry matter recovered and in the dry matter lost (Figs. 3B and 4B).

The quantity of recovered dry matter translocated is much greater in the seedlings grown in the salt solution than in those grown in distilled water. No such conclusion can be reached with respect to light, as the experiment was not capable of establishing differences in weight of less than 7 per cent. In the plants growing in the salt solutions, 0.06 per cent less dry matter was translocated in the seedlings exposed to 100 foot-candle-hour Mazda and in distilled water the light exposure apparently resulted in a 4 per cent increase in dry matter translocated.

The analyses of variance show that the exposure to 100 foot-candle-hours Mazda illumination affects the weight of the meso-

Table 1.—Measurements Expressed as Means of Single Seeds and Seedling Parts When Grown in the Indicated Cultures in Total Darkness and in the Light Shown

Seed or seedling part	Nutrient solution		Distilled water		Standard error of difference
	Dark	100 FC hours Mazda	Dark	100 FC hours Mazda	
	Length (mm)				
Mesocotyl	134.85	100.32	68.80	59.71	3.22
Coleoptile	46.26	48.30	31.67	36.37	1.51
	Weight (g)				
Mesocotyl	.02509	.02047	.01618	.01494	.00075
Tops	.02112	.02503	.01073	.01289	.00077
Roots	.02397	.02464	.02235	.02348	.00077
Seed residue	.1859	.1867	.2073	.1950	.0056
Total dry matter recovered	.2561	.2568	.2566	.2463	.0048
Recovered dry matter translocated	.07018	.07014	.04926	.05131	.00179
Seed planted	.3145	.3159	.3190	.3102	.0056
Lost dry matter	.0584	.0591	.0624	.0639	.0015
Per meter of mesocotyl length	.1861	.2047	.2361	.2505	.0128

Table 2.—Analyses of Variance Based on Means of 20 Seedling Groups for the Seed and Seedling Parts Shown

Source of variation	Degrees of freedom	Mean squares										
		Length		Weight								
		Mesocotyl	Coleoptile	Mesocotyl	Tops[1]	Roots	Seed residue	Recovered dry matter	Recovered dry matter translocated	Seed planted	Lost dry matter	Per meter of mesocotyl
Total	39	940.75	58.94	.0000180	.000040	.000004	.000179	.000119	.000116	.000184	.000024	.0015415
Culture	1	28,444.09†	1,757.48†	.0005220†	.001270†	.000020*	.002285†	.000145	.003950†	.000010	.000079	.0229173†
Light	1	4,758.07†	113.44†	.0000860†	.000090†	.000008	.000374	.000229	.000010	.000162	.000005	.0027117
Interaction	1	1,619.23†	17.74	.0000280†	.000010	.000001	.000158	.000111	.000011	.000280	.000038	.0000451
Error	36	51.88	11.39	.0000028	.000003	.000003	.000158	.000115	.000016	.000187	.000022	.0009568

[1] Includes coleoptile, leaves, and stem. * P<.05. † P<.01.

cotyl and the tops but not the total amount of dry matter translocated. This is illustrated in Fig. 2A and B and Fig. 4A. Evidently even this brief period of low illumination increases the dry matter in the coleoptile and leaves and reduces it in the mesocotyl by approximately an equal amount. The light, therefore, did not increase the speed with which dry matter was moved from the seed but determined its destination by initiating the development of leaves. In a sense, the speed with which

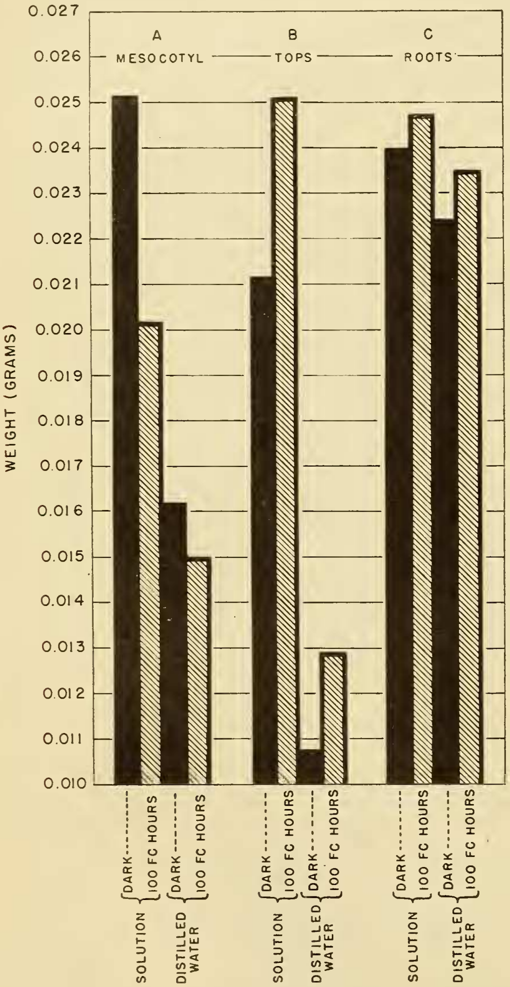

Fig. 2.—Mean weight (g) of mesocotyl (A), tops (B), and roots (C) of maize seedlings grown in distilled water and in nutrient solution. Solid bars represent seedlings always in the dark, hatched bars seedlings subjected to 100 foot-candle-hours of Mazda light four days after planting.

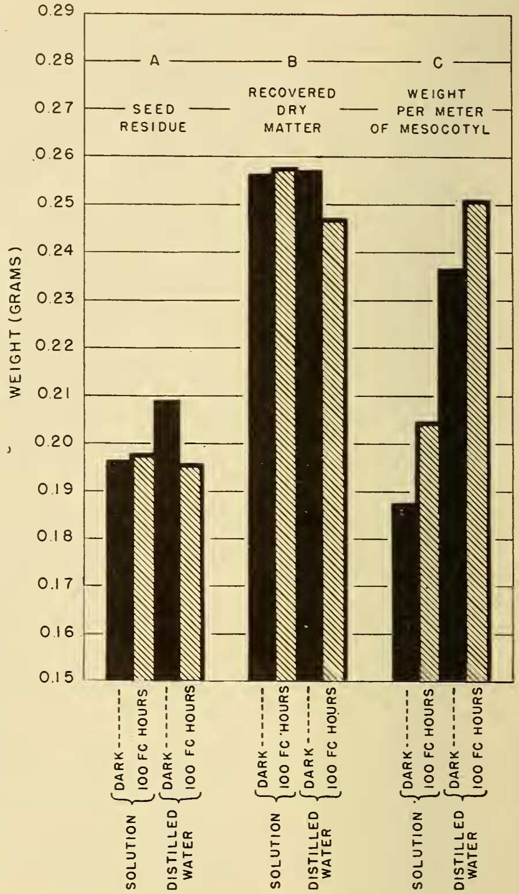

Fig. 3.—Mean weight (g) of seed residue (A), total dry matter recovered (B), and weight per meter of mesocotyl length (C) of maize seedlings grown in the distilled water and in nutrient solution. Solid bars represent seedlings always in the dark, hatched bars seedlings subjected to 100 foot-candle-hours of Mazda light four days after planting.

the solutes travelled up the axis was increased by illumination, since more dry matter was moved into the leaves, but this was accomplished chiefly by stopping the elongation of the mesocotyl, thus reducing the distance from the seed to the leaves. Further, the checking of elongation of the mesocotyl resulted in this organ being heavier per unit length in the lighted series of both cultures, though not significantly so.

Neither the culture nor the illumination affected the quantity of dry matter lost, although the unrecovered dry matter almost equaled the amount translocated.

There is a certain and here unknown loss of weight from diffusion of soluble material into the culture solution and Fig. 4B shows, as would be expected, this factor to be slightly greater in distilled water than in the salt solution. Three other factors contributing to loss of dry matter are in the order of their importance, micro-organisms, oxidation and loss of energy in converting the stored dry matter into soluble forms and finally losses in handling the seedlings. In this experiment this last source of loss must have been inconsequential because the small size of the seedlings made their complete recovery more certain.

The solution used in this experiment is more conducive to leaf development than to mesocotyl elongation, but it exerted a pronounced effect on the sensitivity of the mesocotyl to light. The elongation of the mesocotyl presumably is controlled by growth substances released from the coleoptile, which are inactivated by light. It follows, therefore, that the resistance of these substances to light must be altered by the salts in the solution or else their formation must be reduced. The latter assumption can hardly be urged in view of the very evident stimulation of elongation by the salts in the solution.

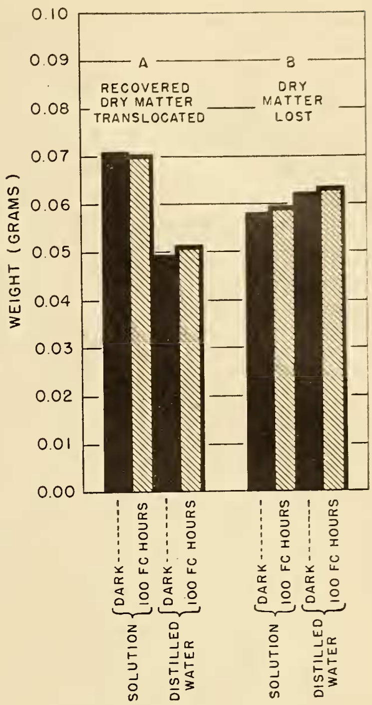

Fig. 4.—Mean weight (g) of the recovered dry matter that had been translocated from the seed to the seedling (A) and dry matter lost (B) of maize seedlings grown in distilled water and in nutrient solution. Solid bars represent seedlings always in the dark, hatched bars seedlings subjected to 100 foot-candle-hours of Mazda light four days after planting.

BOTANY.—*Three new species of Acanthaceae from Mexico.*[1] By E. C. LEONARD, U. S. National Museum. (Communicated by WILLIAM R. MAXON.)

A study of Mexican Acanthaceae in the U. S. National Herbarium and the Dudley Herbarium of Stanford University, in connection with preparing a treatment of the family as it occurs in the Sonoran Desert region, has revealed three new species. These are described herewith. One is from Baja California, another from Veracruz, and the third from the west-central portion of the republic.

Buceragenia ruellioides Leonard, sp. nov.

Herba, caulibus pubescentibus; petioli alati; lamina foliorum oblonga vel late elliptica, breve acuminata vel acuta, basi angustata, parce puberula; flores solitarii vel fasciculati, bracteis foliaceis suffulti; bracteae floriferae lineari-lanceolatae, pubescentes, ciliatae; bracteolae subulatae, puberulae; calyx puberulus, segmentis subulatis, ciliatis; corolla minuta, subregularis, lobis ovatis; stamina inclusa; capsulae glabrae; semina muricata.

Herb; stem simple or probably branched, 40 cm high or more, the pubescence a mixture of minute curved hairs and larger spreading ones up to 1 mm long; petioles up to 3 cm long, winged; leaf blades oblong to broadly elliptic, up to 12 cm long and 5 cm wide, short-acuminate to acute (the tip usually blunt), narrowed at base, the blade gradually long-decurrent, thin, rather veiny, inconspicuously and spar-

[1] Published by permission of the Secretary of the Smithsonian Institution. Received July 16, 1942.